National Aeronautics and Space Administration

Can a Shoebox Fly? Challenge

A Digital Learning Network Experience for Grades 5-12th

Grades	5-12th
Subject Areas	Science, Technology, Engineering , Math

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Digital Learning Network (DLN) Challenge

A DLN Challenge is an in-depth research/design experience that allows students to propose solutions to Challenge criteria and present their solutions to NASA through a videoconferencing system. The educational criteria embedded in the Challenge draws from Inquiry-based and Problem Based Learning strategies. A DLN Challenge involves more than one DLN videoconferencing connection, in-depth student involvement through research and design activities, open-ended problem solving flexibility, and formal student presentations that demonstrate understanding and application.

Grade Level: 5 – 12th

Focus Question:
Using your research skills and applying your knowledge of flight dynamics can you design a shoebox to glide?

5-E Learning Objectives

Engage	The learner will (TLW) prior knowledge about flight dynamics, aircraft design, and NASA's history in aeronautics with the NASA Education Specialist.
Explore	TLW discover NASA's past, present, and future efforts in flight and aircraft designs.
Explain	TLW understand the principals of lift, discover how the four forces of flight affect an aircraft, and how calculations, such as glide-slope ratio, describe the flight of an aircraft by observing on camera demonstrations.
Elaborate	TLW demonstrate their understanding of flight to the design, construction, and test flight of a shoebox-based glider, and collect measurements to calculate glide-slope and aspect ratios.
Evaluate	TLW present their results to the NASA Education Specialist during the second connection through visual and oral summaries of their design and test solutions.

Educational Standards

National Science Education Standards (NSES)

Science as Inquiry – Content Standard A

As a result of activities in grades 5-8 and 9-12, all students should develop:

- Abilities necessary to do scientific inquiry.
- Understandings about scientific inquiry.

National Council of Teachers of Mathematics (NCTM)

Standard 4 – Measurement

In all grades students should:

- Apply a variety of techniques, tools, and formulas for determining measurement.

International Technology Education Association (ITEA)

Standard 10 – Design

- Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving

Texas Essential Knowledge and Skills (TEKS)

(6.5) Scientific concepts. The student knows that systems may combine with other systems to form a larger system.

A. identify and describe a system that results from the combination of two or more systems such as in the solar system; and
B. describe how the properties of a system are different from the properties of its parts.

(8.5) Scientific processes. The student knows that relationships exist between science and technology.

A. identify a design problem and propose a solution;
B. design and test a model to solve the problem; and
C. evaluate the model and make recommendations for improving the model.

Pre-Conference Activities

Download important Can a Shoebox Fly? Challenge pre- activities and detailed instructions at:

http://www.nasa.gov/offices/education/programs/national/dln/events/Can_A_Shoebox_Fly_Challenge_part_1.html

Before Your Video Conference

Audience Guidelines

Teachers, please review the following points with your students prior to the event:

- A videoconference is a two-way event. Students and NASA presenters can see and hear one another.
- Students are sometimes initially shy about responding to questions during a distance learning session. Explain to the students that this is an interactive medium and we encourage questions.
- Students should speak in a loud, clear voice. If a microphone is placed in a central location instruct the students to walk up and speak into the microphone.
- Teacher(s) should moderate students' questions and answers.

Pre Video Conference Checklist

1. _____ Print a copy of the module.

2. _____ Collect pre-activity materials prior to the conference (pg. 5)

3. _____ Have students complete the recommended pre-activities.

4. _____ Review the Audience Guidelines above.

During and After Your Video Conference

Outline for Part 1

- Introduction to NASA
- Today's objectives
- Historical look at Experimental Aircraft and Flight
- Building Engineering Teams
- Aircraft Design Needs
- Developing a Principle of Lift
- Looking at Forces of Flight
- Glide Slope and Aspect Ratios
- Stating the Challenge, criteria and constraints
- Clarification: Student questions, resources, research
- Student presentation expectations
- How to stay in contact
- Good bye to Chase the Problem…as only NASA can!

Outline for Part 2

- Student presentations with evaluation from NASA education specialist

Post-Conference NASA Online Feedback

We value your input! By providing us with feedback, you help continue improving our programs and help them remain free of cost to educators across the country. Feedback from you and a few of your students would be appreciated. Please complete an online evaluation form to provide feedback on the NASA Video Conference Program at http://dln.nasa.gov/dln/content/feedback/. Your presenter should send you more specific instructions after your connection

Digital Learning Network

Certificate of Completion

This certifies that

Has completed NASA's
Shoebox Glider Challenge

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Instructor

Vocabulary

Airfoil – parts of an airplane, such as wings, tail surfaces, and propellers, designed to cause a dynamic reaction from the air through which it moves.
Aeronautics – the science and art of flight through the atmosphere.
Aspect Ratio – the length of a wing divided by the width (cord).
Aerodynamics – the branch of mechanics dealing with forces exerted by air or other gases in motion.
Angle of Attack – the angle created by the pilot during takeoff, the angle between the chord line and the oncoming relative wind.
Bernoulli's Principle – states, "as a fluid's speed increases, the pressure within the fluid decreases." So the pressure on top of an airfoil must be less than the pressure below.
Cambered – curved upper surface on a wing to increase lift.
Chord – (airfoil) an imaginary line that connects the leading edge with the trailing edge of the airfoil.
Drag – a slowing force acting on a body (as an airfoil or airplane) moving through air, parallel and opposite to the direction of motion.
Force – the cause of motion. Power or energy exerted against an object in a given direction.
Fuselage – the basic structure of the airplane to which all the other parts are attached.
Glide Slope Ratio – the horizontal distance divided by the change in altitude.
Gravity – the term used to describe the force of attraction that exists between all matter within the universe.
Lift – the upward force that opposes the pull of gravity.
Lateral axis – an imaginary line that runs from one wingtip through the fuselage and exits the other wingtip. Also called the pitch axis.
Leading edge (airfoil) – the edge that meets relative wind first.
Mass – the amount of material in an object.
Relative wind – opposite the flight path and impacts the airfoil at any angle to the chord line.
Stall – separation between the streamlines and the airfoil causing loss of lift producing low-pressure on the top of the wing.
Thrust – the force exerted through the propeller shaft of an airplane due to reaction of the air on the revolving blades of the propeller and that moves the craft ahead.
Trailing edge (airfoil) – the thin junction where the upper and lower surfaces come together at the rear of the wing.
Weight – force that directly opposes lift.
Wing – primary source of lift with ailerons attached.

Resources

The Beginners Guide to Aerodynamics (Grade 6-12)
How do airplanes work? Why does a wing change shape on takeoff and landing? Start your journey into aerodynamics.
http://www.grc.nasa.gov/WWW/K-12/airplane/bga.html

FoilSim (Grades 6-12)
FoilSim was developed at the NASA Glenn Research Center in an effort to foster hands-on, inquiry-based learning in science and math. FoilSim is interactive simulation software that determines the airflow around various shapes of airfoils.
http://www.grc.nasa.gov/WWW/K-12/FoilSim/index.html

X-1 Paper Glider Kit (Grades 5-12)
http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/X1.Paper.Glider.Kit.html

Space Shuttle Glider (Grades 5-12)
http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Space.Shuttle.Glider.html